

Theses for the Future of Water Sensitive Urban Design (WSUD)

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Abstract

Based upon the analysis of case studies with an emphasis on storm water management as well as urban and landscape design interim theses for successful planning and implementation of 'Water Sensitive Urban Design' are made within WP 5.1 in Hamburg.

Keywords: water sensitive urban design, storm water management, urban and landscape design

1 Conclusions 'Water Sensitive Urban Design'

Based upon the review of case studies the state of the art and the best practice of 'Water Sensitive Urban Design' (WSUD) were surveyed in WP 5.1 in Hamburg. The objectives of the review were discussed and refined with the members of the learning alliance Hamburg. The following goals were identified:

- On the one hand WSUD should facilitate a 'qualified inner city development'. The strategy of the municipality of Hamburg is characterised by densification and redevelopment of brown-field sites and should enable a sustainable management of urban growth (FHH 2006). Preconditions for the inner city development are economical, ecological, social and cultural sustainable solutions for storm water management. Limitations on urban development should be avoided. The qualified inner city development requires the creation of attractive locations and should realise synergies with demands of storm water management.
- On the other hand WSUD requires the implementation of measures related to storm water management within the scope of urban development. Also the demands of future developments (e.g. the climate change) have to be considered. In the municipality of Hamburg storm water management should follow the natural water cycle, so that fluvial flooding and overflows of combined sewers can be avoided. Also additional objectives like the management of high ground water tables, flood protection or eco sanitation should be taken into account.

These demands reinforce why the review of WSUD in Hamburg focussed on storm water management. As part of the survey factors related to design, function, concept and the planning process were

described in context of solutions to the management of storm water. It was analysed if the factors correspond to the demands of sustainable storm water management or if modifications are required. Based upon the results interim theses for successful planning and implementation of WSUD were set up. They will be refined in the further course of the research project.

2 Design, function and dimensioning

Thesis 1: The safety levels as established for storm water management have to be guaranteed for future demands.

The 'safety level' has got causal impact on the dimension and the structure of storm water management systems. All reviewed case studies have a safety level (drainage of settlements, avoid flooding etc.) which is suitable for the present demands. Because of changing basic conditions (e.g. expected climate change) the future guarantee of the established safety level gains in importance.

- In 'Neuallermoehe West' the canal system provides a big retention volume. Therefore the capacity of the storm water management is adequate for the present state as well as for future changes (e.g. increasing rainfalls, varying volume of water etc.).
- In 'Dorfanger Boberg' the cross-sections of the ditches are affected by the needed safety level as well as the demand to minimise the dimensions (e.g. facilitate the integration in the urban and landscape design). Therefore the guaranteed security level is suitable for the present demands. But the system of storm water management does not have voluminous and unexploited capacities, therefore it is not predictable if the present security can be guaranteed for changing basic conditions. It is of interest if there are possibilities to adapt the capacity with selective measures or if there are design solutions for varying water volume.
- In 'Heidberg Villages' there is an inversion of the principle related to protection. The construction of dwelling mounds 'protects' buildings and infrastructure against storm water. Therefore the whole area of open space is available for the management of storm water and a high capacity of the system is guaranteed. Analysis is necessary if the concentration on elements worthy of protection enables to guarantee a sustainable security level as well as the handling of varying water volumes.

In the case studies as well as in the technical literature (e.g. Sieker et al. 2006 or Geiger, Dreiseitl 2001) the guarantee of the established safety level for future demands gains in importance. Therefore it is necessary to analyse how the capacity (and related the security level) of storm water management systems can be adapted to changing basic conditions. On the one hand there are solutions required to manage increasing rainfalls in existing storm water management systems. On the other hand the measures of storm water should take varying water volumes into consideration. Therefore the approaches to steady or to design the varying storm water volume have to be advanced. A co-operation with WP 2.1 'Technological options for storm water control under conditions of uncertainty' could be useful.

Thesis 2: The guarantee of a good water quality of storm water should gain further in importance.

In the case studies a good water quality of storm water was an essential precondition for several possibilities to handle storm water and to realise the demands of ecological, social and cultural sustainability.

- In the case study 'Trabrennbahn Farmsen' the storm water is primarily treated in sedimentation basins before it flows into the existing natural ponds. This treatment is necessary because of ecological reasons to guarantee a good water quality of the ponds.
- In 'Neuallermoehe West' an elaborate flushing of the canal system is carried out to guarantee a good water quality. The water quality should facilitate the usage for leisure time activities and the development of attractive locations.

Sustainable storm water management requires the preparation of a good water quality. Therefore the treatment of storm water should gain further in importance. Also other current research projects (compare Regge en Dinkel Water Board 2006) deal with the topic of storm water quality. In future the approaches to treat storm water should be advanced and the application field clarified. Maybe a co-operation with WP 4.1 'Eco-sanitation and decentralised waste water management in an urban context' is helpful.

Thesis 3: An adequate urban and landscape design of the measures of storm water management - emphasis or inconspicuous integration - is required.

The case studies illustrate that dependent on the interaction of several factors some measures of storm water management are suitable for an emphasized urban and landscape design. On the contrary other elements of storm water management require an inconspicuous integration into the environment.

- In 'Neuallermoehe West' water bodies with a shining urban and landscape design were developed. The shining design facilitates the realisation of synergies. Therefore a sustainable storm water management as well as the development of attractive locations at 'Neuallermoehe West' is enabled. Important but not obligatory demands for an emphasized design are: permanent water bodies with a good water quality, an increased significance of water bodies, connections between the water body and the adjacent areas, the location of the water body in the settlement, sensitive handling of the topography, highlighting of single elements etc.
- The case study 'Dorfanger Boberg' illustrates that some measures of storm water management are less suitable for the development of attractive locations (e.g. non-permanent water bodies, small scale structures, unsuitable location etc.). For these elements an inconspicuous integration in the surrounding urban and landscape design is appropriate. In 'Dorfanger Boberg' several approaches for a good integration were noticed. Because of the small dimensions and the possibilities of a multi use, the drainage troughs were integrated in the private gardens. Also it was helpful to realise short storm water sewers to avoid single design problems caused by the topography. Furthermore the development of an ensemble of ditches, vegetation and paths facilitates the integration because the ensemble acts as an element of landscape design.

Problems to develop a suitable design vocabulary for measures of storm water management were already recognized by Beneke 1999. The case studies clarified that several disagreements of urban and landscape design can be reduced to an inappropriate usage of design potentials. Because of this further research should not be confined to the development of new design approaches only but also focus on the suitable adaptation of the existing design vocabulary. So the design potentials of storm water management as part of cultural sustainability can be performed.

Thesis 4: The connection between the measures of storm water management and the adjacent areas should gain in importance.

The connection between the measures of storm water management and adjacent areas is an important precondition for the realisation of the design potentials of the storm water management and the development of attractive locations. The case studies illustrate that the connection is facilitated by several factors:

- At the 'Trabrennbahn Farmsen' the visibility of the water body is important for the connection between the measures of storm water management and the environment. Therefore the storm water is visible in the public streets as well as in the public green space.
- In the case study 'Neuallermoehe West' the access to and the usability of water or at least the embankments are preconditions of a successful connection to the bordered areas. The canals in 'Neuallermoehe West' have a public and a private bank to facilitate a broad range of several usages near the water (from leisure time activities to private terraces). The connection is also encouraged by elements which facilitate a multifunctional usage (e.g. the realisation of small runnels for the average water volume and some open space for storm water peaks). The multifunctional usage of the areas for storm water management is an approach to reduce the use of additional settlement areas.
- The quarter 'Heidberg Villages' illustrates that the handling of the topography and the differences in altitude caused by the storm water management are important. The dwelling mounds which protect the buildings and the infrastructure were constructed with steep embankments. These embankments (and missing possibilities for access) obstruct the usage of the remaining open space. Also the design of the remaining public space is affected. The non-sensitive handling of the topography affects the implementation of this planning approach.
- 'Dorfanger Boberg' clarifies that the correlation of measures related to storm water management to appropriate land uses is an important precondition. So one retention basin is integrated in the central public green space and facilitates the identity of 'Dorfanger Boberg'. On the contrary another retention basin is situated at the edge of the settlement without any connection to public green space and does not contribute to the development of an attractive quarter.

The listed factors and effects facilitate or inhibit the connection between the water bodies and the adjacent areas. A connection enables the implementation of synergies between storm water management and urban planning. The connection between the water and the environment should gain further in importance to realise the functional and design potentials of storm water management.

Thesis 5: The remaining scope of design concerning storm water management should be handled by general rules of urban and landscape design.

In the case studies was noticed that beside the different water related demands and potentials there is still a wide scope for the design of measures related to storm water management. To manage this scope general rules of urban and landscape design should be applied.

- In the case study 'Neuallermoehe West' the canals have a very strict and linear design vocabulary which can be traced back to the overall appearance of the surrounding marshland. The design approach takes the context of the surrounding landscape and built environment into consideration. But also other general rules of urban and landscape design (e.g. the correlation of function, the exposure to light, guarantee the privacy of parcels etc.) were considered in 'Neuallermoehe West'.

General rules of urban design and landscape architecture enable to adjust the broad scope of design which is not influenced by water related demands. These approaches facilitate the construction of sustainable storm water management systems as well as the development of attractive locations. Therefore the implementation of general rules of urban and landscape design in context of storm water management should gain further in importance.

3 Concepts of storm water management

Thesis 6: Concepts of storm water management should consider synergy-effects and multi-criterion-methods to increase the effectiveness.

As already mentioned before different interests starting with the surroundings, quality and quantity of water but also the competition, the planning process and the development process influence the design of storm water management. The optimisation of the design and the storm water management is not simply done by altering a single factor. Specially in terms of the warranty of sustainability it is important to look at the whole system and to adjust several factors that influence a system of sustainable water management. The following case studies give an impression why there is a prevalent need of adopting a multi-criterion-approach during the planning process:

- In terms of the case study 'Heidberg Villages' the matters of water management oversized the original idea of design during the translation into planning and water management law. The strict one-to-one implementation left its mark on the development area. The calculated need of effluent and infiltration led together with the design of dwelling moulds, infiltration and retention basins to a large area of green space. The green spaces rather appear to be broad ditches even though the original design followed the opposite idea of developing no ditches at all. Because of the design and because of the defined uses parts of the green areas are not useful to the public even though they are not permanently needed for matters of water management.
- The 'Trabrennbahn Farmsen' shows a good linkage of different aspects during the process of design, planning and implementation. Various needs and interests were interlinked and contribute to the overall image. In terms of sectoral planning the alliance of for example nature conservation, an open drainage system, the quality of sojourn and further social and economical issues led to a deliberate and accepted design. The brick ponds and the sensitive exposure to the existing topography supported the idea of an open drainage system. The possibilities of usage by residents and the quality of sojourn abet the water management and strengthen the acceptance which is important for a long term existence of a development. It has proved to be right not to separate different needs but rather integrate and combine different needs as for example play grounds, open spaces, private and public spaces.

The case studies revealed that in the context of SWITCH neither matters of design nor water should be understood as a single element but rather as an integrated part of an overall concept. At present different matters of importance for a development are rather regarded singularly. The pursuance of a multi-criteria approach based upon indicators of sustainability can generally contribute to the consideration of all relevant matters. It is important to further research concerning methods of implementing a multi-criteria approach. In this context the achievement of synergy-effects would be one desirable and innovative goal of an overall management plan concerning the matters of planning and water management. The relevance of this statement further emphasizes the need of linking SWITCH activities. A cooperation with WP1 and WP2 providing expertise concerning indicators of sustainability, decision support systems (DSS) and storm water management information systems (SMIS) would be supportive.

Thesis 7: Concepts to handle storm water have to be developed to profound 'management' concepts rather than remaining concepts mainly based upon constructional measures.

There is a general tendency to develop not only building sites but to develop sites within an overall context of city coordination and planning. This mainly contributes to the integration in the surround-

ings and a longterm acceptance. Therefore the need is coexistent to develop profound management concepts which can directly influence the design and appearance of an open drainage system.

- The case study of the 'Trabrennbahn Farmsen' exposes various possibilities and approaches of realising an overall management for the development site including the system of water management. The whole development and open space reflects a very cultivated impression. Specially in comparison to other major settlements of that time. The open drainage system is accepted by the inhabitants and works well ever since the completion of the development. A 'corporate identity' has been built up. The surrounding infrastructural facilities are also integrated in the overall management system. The land owner with a office at the site and a permanent presence is responsible for matters of maintenance concerning the whole area including the open drainage system. It also serves as contact in case of problems.

A broader approach is favourable which should not only combine issues related to design and construction but also provide a management concept comprising future operation and maintenance. In particular with planting and water being no statical system the development is not finished with the completion of the construction phase. Continuous maintenance mainly contributes to a long-term existence and the future performance related to functions. The features of water have to be taken into account not only in the planning and construction phases but also in relation to a long-term future after the construction is finished. This also is a desirable aim in terms of sustainability.

- In the case study of 'Heidberg Villages' a water associations takes over responsibilities for the function of the water management system mainly including the maintenance. This model works out well with the owners being financially responsible for the water system. This can be understood as a first contribution to an overall management system.
- Supplementary to the water association the organisation of 'Dorfanger Boberg' goes far beyond this only water related model. With the organisation of markets for sharing services and possessions or carsharing facilities it also has a high social value. It would be desirable to push this model forward in terms of the water management and the design of the site in general.

Profound management concepts combine various matters and give a long-term future perspective. The reliance on single constructional measures cannot provide such an overall and integrated approach. Research should again draw upon indicators of sustainability and multi-criteria methods in advancing samples of management concepts related to storm water and urban planning.

Thesis 8: Not isolated applications but cross-border concepts should be developed for storm water management.

As already approved by Beneke 2003 development plans and therefore the water management are usually restricted to the scope of the plan itself. Only one of the case studies took existing or future building activities in the surroundings into account in relation to the open drainage system. The other case studies just showed attempts of integration or linkage. The design or the water management are usually only influenced at direct connection points where issues might occur related to the site. Issues are for example the capacity of the storm water sewer or of the receiving water body.

- In case of 'Neuallermoehe West' the idea of bonding different city quarters in relation to the water management can be visibly comprehended. The dimension of the open water course covers the quarters 'Nettelburg', 'Neuallermoehe Ost' and finally 'Neuallermoehe West'. Because of the interlinkage and the integration of the water network various benefits and synergy-effects can be identified. On the one hand infrastructural facilities related to the water system e.g. the pump station can be shared. With the application of an approved water management system the risk of failure or malfunction could be minimised. Further the water network serves as a link in design and provides recreational possibilities.

- The development of the case study of 'Rahlstedt Merkur Park' was approved because of the possibility of developing another commercial site called 'Hoeltigbaum' right next to it. The two developments took place individually and separate from each other. The water management system was not connected and it was not even thought of that possibility during the planning and construction phases of 'Merkur Park'.

It would be favourable to regard the whole water system as a network. In terms of the water balance this would be an important approach to guarantee matters of sustainability as single development areas differently influence the water system. Building sites should not be regarded individually but in relation to other development activities. Future monitoring and constant enhancement of water management systems are favourable. A cross-border concept for the water management facilitates the pursuit of complex goals concerning water management on a superordinated level. The modification of single elements can be easier dealt with as goals of sustainability still can be reached within the overall context. This also offers further possibilities related to the design.

4 Planning process

Thesis 9: The well known importance of the demands related to a fair planning process could be confirmed.

The case studies demonstrate that demands of a fair planning process were causal for a successful realisation of sustainable storm water management systems.

- In case of 'Neuallermoehe West' an interdisciplinary coordination between sectoral planning was guaranteed. Committees and management teams were established for the interdisciplinary coordination. These organisational measures were an important precondition for the realisation of synergies. For important development projects the city of Hamburg generally follows the approach to set up management teams in terms of planning and implementation.
- At the 'Trabrennbahn Farmsen' a faire stakeholder involvement (in particular the inhabitants concerned) was an important precondition for the qualification of the planning results. On the one hand the special demands of the prospective users of the storm water management system could be considered early. On the other hand the stakeholder involvement at the 'Trabrennbahn Farmsen' goes far beyond the development phase and was brought forward.
- Several efforts of the district of 'Wandsbeck' to realise systems of storm water management could be assigned to the dedication of the water management department. The dedication of single participants (so called 'doers') could be confirmed.
- In the case studies also several problems concerning planning and realisation were noticed, which were caused by the laws and policies for storm water management. So it is not allowed to divert storm water from private properties in ditches at public streets. These problems have to be solved in the planning process.

Various authors (e.g. Bischoff, et. al. 2005) already described the importance of the demands of a fair urban planning process. These well known demands are also an important precondition for the realisation of socially sustainable solutions of storm water management and should be taken into consideration.

Thesis 10: The planning process in terms of storm water management should enable the development of location-based solutions.

The case studies demonstrate that the realisation of sustainable storm water management is not possible with a schematically implementation of solutions. Rather the development of location-based solutions for storm water management is necessary.

- In the case study 'Neuallermoehe West' the design as well as the function of the canal system is location-based. The guiding principles for the structure and the design vocabulary of the canal system were developed on the basis of the appearance of the surrounding landscape. Therefore the strict and linear design vocabulary of the canals corresponds with the adjacent marshland. Also the operating of the canal system with flushing gates and pumping station is comparable with the operating of the ditch network in the marshland. The case study 'Neuallermoehe West' clarifies the importance of learning processes to enable location-based solutions. The new canal system of 'Neuallermoehe West' compared to the old canal system of 'Neuallermoehe East' presents several improvements (better connections between the private parcels and the canal, appropriate design of the bridges etc.). 'Neuallermoehe West' also demonstrates that open planning processes with a step-by-step development of the results enable a successful implementation of a location based design.

The development of location-based solutions requires learning processes to facilitate the transfer of experiences, to scrutinise habits etc. Also various authors (e.g. Raith 1998 or Beneke 2003) recommend the general design approach to take the context of the surrounding landscape and settlements into account. This approach enables the development of location-based and customized design of storm water management systems. Therefore the implementation of this approach in context of measures related to storm water management should gain further in importance.

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